U.S. Department of Agriculture Agricultural Research Service Vol. 33, No. 6, June/July 1985

# Agricultural Research




## Searching Soybeans' DNA Blueprint

Story on page 6

## Values That Work

After studying a number of America's best-run companies, Tom Peters and Bob Waterman, the authors of *In Search of Excellence,* offer managers some thought-provoking advice.

"Figure out your value system," they say. "Decide what your [agency] stands for. What does your enterprise do that gives everyone the most pride?"

I have asked these questions of myself and of other managers of the Agricultural Research Service, and we have come up with several observations about the values that drive our agency.

First is a belief in the power of agricultural science as an overwhelming force for good in the world. We share the conviction that only through agricultural research can we improve our productive efficiency and mobilize our unused capacity to meet the ever-increasing demands of a hungry world.

To many of us, agricultural research is the highest application of mankind's scientific genius. For by using science to feed this planet's burgeoning population, we are also using science to endow human lives with health and dignity—people whose only outlook used to be one of despair.

Second in the ARS value system is a commitment to excellence in solving research problems. This includes pride in one's own discipline and a shared pride in the work of our associates. It is an unusual day when I fail to receive word of some new honor or award bestowed on one of our fellow ARS scientists. Since 1962, five ARS scientists have won the prestigious National Medal of Science, out of a total of 185 scientists to receive this honor. That is truly strong evidence of the scientific commitment to excellence that we share in this agency, and it demonstrates the pride that our researchers feel about their work.

Third among our shared values is a commitment to productive relationships with industry. Last year, we had more than 60,000 contacts with business and industry to transfer our technology to the private sector. Many of these contacts were face-to-face discussions. Last year, our National Program Staff met with no fewer than 150 industry and commodity groups, and I was able to participate in 30 of these meetings. Such discussions and contacts help keep our 2,650 scientists operating in the "real world" of commerce and agriculture—and they help business people, too.

We also share a belief in innovation and a determination to get the job done. There have been too many stories—and instances—of bureaucracies dragging their feet, of endless roadblocks and bottlenecks to action. That doesn't happen in our agency.

I believe that our scientists and their support people will try just about anything to uncover funds, find space, and jury-rig equipment to solve research problems and keep useful research projects on track. It is difficult to say "no" to an enthusiastic, dedicated scientist.

One ARS manager calls this value "a bias toward action." Perhaps another way to put it is "bulldoggedness." Whatever you call it, it represents an attitude that is anything but bureaucratic.

Fifth, we tend as a group to favor prompt and decisive decisionmaking at the top and prompt and decisive followthrough on down the line once decisions have been made. This is not unique to ARS; Secretary Block sets this tone.

While not everyone approves of every management or research decision that is made in this agency, most employees do appreciate firm resolve at the top. They know that tough decisions have to be made from time to time for the good of the agency.

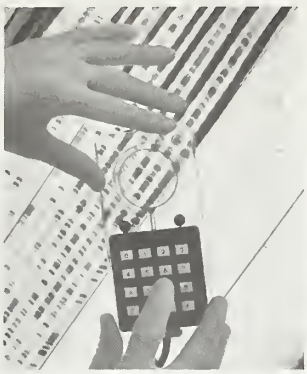
What enables our employees to accept management decisions they don't particularly like is loyalty to the agency and its aims. And perhaps that should be listed as the final one of our shared values—*loyalty.* ARS people have the quality in abundance; they demonstrated their loyalty during the most trying times of our recent reorganization.

These are some of the values that help make our agency one of the finest research organizations in the world. A belief in the power of science to change the world for the better. A commitment to excellence. Good working relations with the private sector. The desire to get things done. Prompt decisionmaking and followthrough, and loyalty to the aims of the agency, even when individual decisions are hard to swallow.

These values might not work for every agency, but I think they work for us.

Terry B. Kinney, Jr.
Administrator

# Agricultural Research



Agricultural Research Service plant geneticists in Beltsville, MD, are determining the structure of a soybean DNA segment that resembles the movable genetic elements first discovered in corn. Each band represents a "letter," or nucleotide, in the genetic code. This research could lead to soybean improvements. Story begins on page 6. (0484X525-23)

Correction: May 1985 p. 4. Caption for "Above" photo should have read: Photomicrograph of *Ascosphaera apis*. The fungus that causes chalkbrood disease in honey bees.

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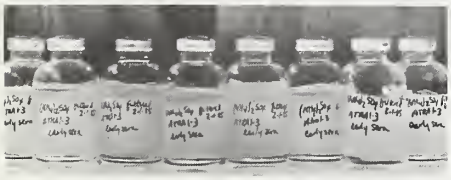

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**DEPARTMENTS**




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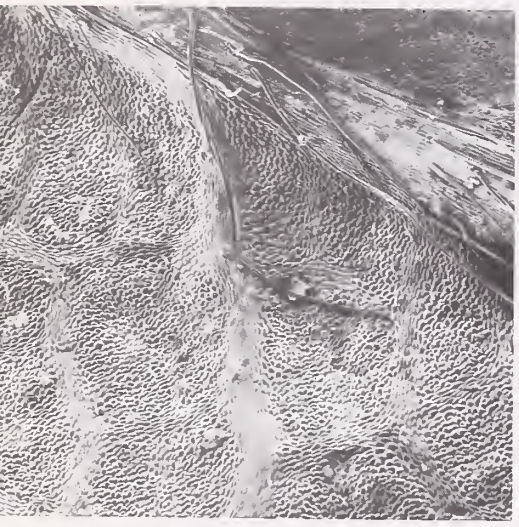
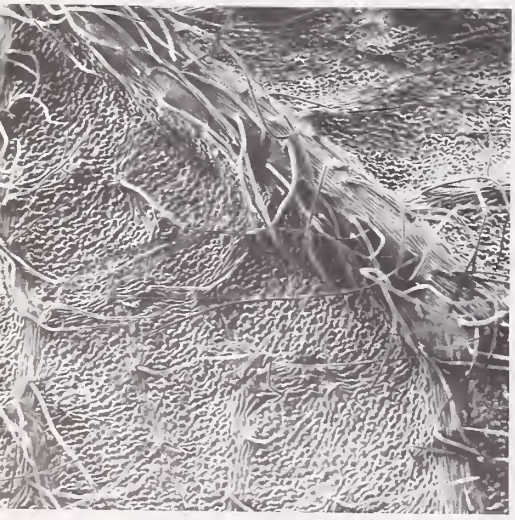
## Hairy Leaves May Offend Insects

An unusual type of natural resistance protects some strawberry plants from destructive root weevils.

Robert P. Doss, an Agricultural Research Service plant physiologist in Corvallis, OR, made the discovery while examining a number of clones of highly weevil-resistant strawberry plants. He was expecting to find a chemical basis for the resistance.





The bottom photo shows heavily haired underside of leaf of particularly resistant beach strawberry (Fragaria chiloensis). (PN-7163). Top photo shows lightly haired leaf of nonresistant strawberry. (PN-7162)

But instead, after exploring many false leads, Doss noticed that the undersides of the leaves of one particularly resistant beach strawberry *(Fragaria chiloensis)* were heavily haired.

Doss now believes the clone he examined owes its resistance to these leaf hairs. "When we removed the hairs, the plant lost its resistance," says Doss.

Although there may be other components of resistance, Doss says leaf hairiness certainly seems to correlate with resistance to black vine weevil and may also inhibit feeding by other weevils.

Doss and Carl H. Shanks, Jr., an entomologist at Washington State University at Vancouver, WA, are now studying why leaf hairiness affects weevil feeding. Shanks has a collection of many beach strawberry plants, which he gathered from a number of sites in California, Oregon, and Washington.

The two scientists are conducting experiments with Washington State plant breeder Thomas M. Sjulin to determine if resistance to weevil feeding can be readily introduced into commercial strawberries.

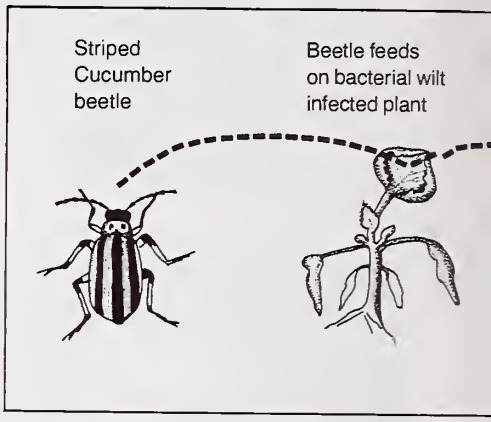
The search for a natural resistance to root weevils gained importance in 1974 when pesticides that controlled the weevils were banned. The weevils have been increasing in numbers and damaging more plants ever since.—**Howard Sherman,** Albany, CA.

*Robert P. Doss is at the USDA-ARS Horticultural Crops Research Laboratory, 3420 N.W. Orchard Avenue, Corvallis, OR 97330.* ■

## Midwest Melons Gaining Ground

With cantaloups making an economic comeback in the Midwest, the Agricultural Research Service is stepping-up the search for more disease-resistant varieties.

In the Midwest, cantaloup—also known as muskmelon—plants



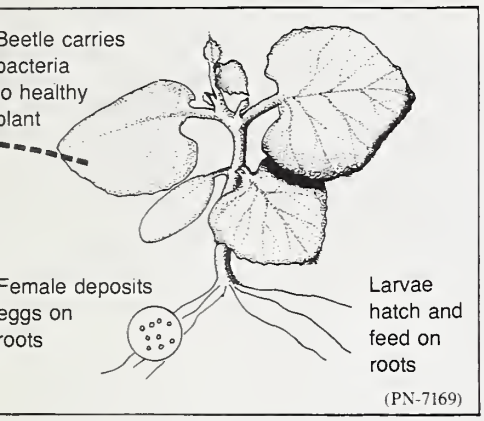

are subject to bacterial wilt *(Erwinia tracheiphila).* The number of available varieties resistant to this disease declined along with production when the growing area shifted to the West Coast during the forties and fifties.

In a recent 3-year study, ARS entomologist Gary L. Reed, in Vincennes, IN, screened 187 muskmelon varieties for bacterial wilt resistance, in cooperation with Walter R. Stevenson, a University of Wisconsin plant pathologist.

The scientists inoculated seedlings with the disease-causing bacteria in greenhouse trials and subjected other plants to bacteria-infested beetles in field studies. The only way the plants may become infected naturally is through the feeding of infested beetles.

Reed and Stevenson found three varieties that showed high resistance to bacterial wilt—'Burrell's Gem', 'Early Wonder', and 'Jewel'—with Burrell's Gem performing the best in all trials. It had the lowest overall disease rating, and surviving plants showed no symptoms of bacterial wilt.

Reed's interest in muskmelon is caused by an upswing in melon growing after a 30-year decline. He estimates that muskmelon acreage in the Midwest reached a high of 12,000 to 15,000 acres in the early fifties and then dropped to about 4,000. "But recently, because of increased numbers of farmers' markets, higher transportation costs for shipping in melons from




California, and lack of more profitable crops, melon acreage in the Midwest has been rising again," he says.

Seed for the study came from melon breeders, the vegetable seed industry, and the ARS National Seed Storage Laboratory at Fort Collins, CO.—**Betty Solomon,** Peoria, IL.

*Gary L. Reed is at USDA-ARS, Fruit and Vegetable Insects Research, P.O. Box 944, Vincennes, IN 47591.* ■

## Shipping Fever? Try Yeast

Adding yeast to cattle feed can prevent shipping fever, a respiratory disease brought on by the stress of being shipped.

The stress causes cattle to lose their appetites, and the loss of nutrients lowers their resistance to the ever-present viruses and bacteria that cause the respiratory disease.

William A. Phillips, an animal nutritionist for the Agricultural Research Service in El Reno, OK, says, "We found adding yeast to the diet of stressed beef calves at a rate of only 1 percent can increase food intake by 36 percent and rate of weight gain by 27 percent during the first week after stress, as compared with calves receiving the same diet but without added yeast."

The most rapid weight gain occurred during the first week of the trial, and feed consumption of the calves fed either diet nearly doubled by the fourth week. "The rapid initial weight gain was probably due to reestablishing the gastrointestinal fill," Phillips says.

Phillips also notes that the calves did not respond to an increase in the yeast additive. Doubling the yeast intake did not cause the calves to eat more or gain more weight.

Veterinary medical officer David L. VonTungeln, who also participated in the study, says, "Yeast culture is a natural feed additive that can increase feed intake and weight gain in cattle that are not under stress, and now we see that yeast has the potential to be helpful in preventing bovine respiratory disease as well."—**Bennett Carriere,** New Orleans, LA.

*William A. Phillips and David L. VonTungeln are at the ARS Livestock and Forage Research Laboratory, P.O. Box 1199, El Reno, OK 73036.* ■

## Hydrochilling Keeps Meats Fresh Longer

A new rapid-chill technique could allow meat to be chilled, packaged, and shipped the same day an animal is slaughtered.

Still in the experimental stage, the technique, called hydrochilling, involves spraying the meat with a refrigerant solution at 15 degrees below zero. Raymond A. Stermer, an Agricultural Research Service scientist in College Station, TX, says, "This contrasts with conventional slaughter plants where meat is air-chilled in refrigerated rooms for 24 hours or more. Our method is three to five times faster."

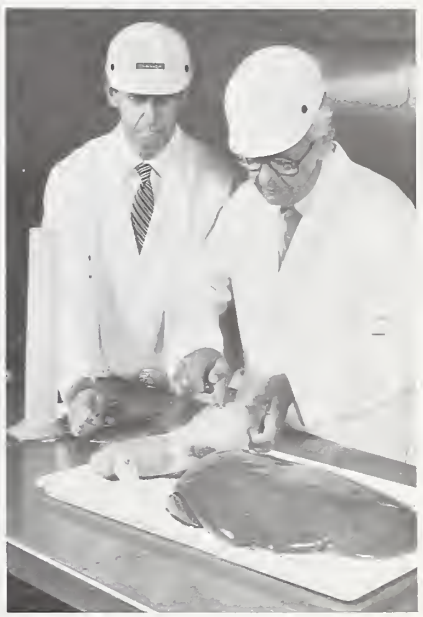
Hydrochilling reduces the amount of meat shrinkage and lengthens the shelf life of meat by reducing chances for bacterial growth.

Extending the shelf life of meat another 15 to 20 days would make it possible to sell fresh variety meats—such as liver, hearts, kidneys, and tongues—to Europe, where they command a premium price.

Propylene glycol, one of the most promising solutions used in the hydrochilling experiment, is currently approved for use on vacuum-packaged meats but not for direct contact with unpackaged meat. Clayton F. Brasington, a colleague of Stermer's, says, "We will petition for approval of direct-contact use when enough research has been done to demonstrate its safety."

"Our research team, which includes scientists from Texas A&M University, foresees that a short rinse with clean, chilled water could reduce the residual levels of propylene glycol low enough to allow approval for the solution," Brasington says. "Or we might investigate packaging before hydrochilling."—**Bennett Carriere,** New Orleans, LA.

*Raymond A. Stermer and Clayton F. Brasington are at USDA-ARS, Meat Processing and Marketing Research, P.O. Box ED, College Station, TX 77841.* ■



ARS engineers Raymond A. Stermer (right) and Clayton F. Brasington install thermocouples in meat to monitor temperatures during hydrochilling, an experimental technique that could extend the shelf life of meat. (0858X438-7)

# Movable Gene Element Found in Soybeans

ARS plant geneticists Lila Vodkin (right) and Patsy Rhodes determine the structure of a soybean DNA segment. They use a photographic negative exposed by radioactively labeled nucleotides that were chromatographically separated in a gel. (0484X524-9A)

An odd chunk of soybean gene material, found by two Agricultural Research Service scientists, has provided the first evidence for mobile elements among the genes of soybeans. Mobile elements—sometimes called jumping genes because they change places on a chromosome—could provide a key to genetic engineering of crop plants, say the soybean element's discoverers, plant geneticists Lila O. Vodkin and Patsy Rhodes, Beltsville, MD.

The makeup of the new soybean elements is surprisingly similar to mobile gene elements already found in corn and snapdragons, say Vodkin and Rhodes. Key sequences of the soybean gene element resemble the sequences of transposable elements in corn first described by geneticists Barbara McClintock and Peter Peterson in the early 1950's. McClintock received the 1983 Nobel Prize for her work with "jumping" genes.

Could these mobile or transposable elements possibly be readymade molecular tools for plant genetic engineering? Yes, say the two ARS scientists. Researchers may be able to use them as carriers to move genes from one species into the chromosomes of another.

Vodkin points out that recent research on fruit flies has fueled expectations along this line. At Carnegie Institute of Washington in Baltimore, MD, scientists have attached a fly gene containing information for eye color onto a transposable element, then injected the fused product into embryos of flies with a rosy mutant eye color. Up to half of the embryos matured with normal-color eyes, indicating that the attached gene made it into the genetic blueprint for the fruit fly and the blueprint was read properly.

To date, most successful genetic engineering has involved simple, single-celled life forms. Most notable is the commercial harvesting of human insulin from vats of genetically altered bacteria.

Genes encode the structural information needed for cells to grow

and divide and produce the traits that characterize a complex organism like a higher plant. Most genes occupy fixed positions along the chromosomes of the cell.

When they move, transposable elements can turn on or turn off the structural genes they invade and even alter the developmental time for the tissue in which a structural gene is expressed.

It was this ability to control the activity of a structural gene that led Vodkin and Rhodes to the soybean transposon *Glycine max*—Tgm1, for short.

A mutation involving a soybean seed protein, lectin, has proven to be a good genetic system to study at the molecular level, Vodkin says. She explains that lectin alone accounts for as much as 5 percent of the total seed protein. However, seeds of some naturally occurring mutant soybeans have no lectin at all.

In order to solve the riddle of the lectin mutation, Vodkin and Rhodes first needed to determine the linear sequence of the nucleotides in the lectin gene.

Genetic information is "printed" in a sort of digital fashion along the braided strands of DNA (deoxyribonucleic acid). The information is stored in sequential arrangements of the four basic units, or nucleotides, of DNA molecules.

When the sequence of the lectin gene from the normal variety was compared to that of the lectin gene from the lectinless soybean line, Vodkin and Rhodes unexpectedly found that a large piece of DNA had split the abnormal line's lectin gene into two regions. The split indicated that a transposable element had invaded the lectin gene in a manner similar to that used by elements in bacteria and other systems.

Aside from the possible use of transposable elements for genetic engineering, Vodkin believes they can potentially be used to identify and isolate other genes of interest from among the hundreds of thousands of different types of DNA molecules present in the cells of higher plants.

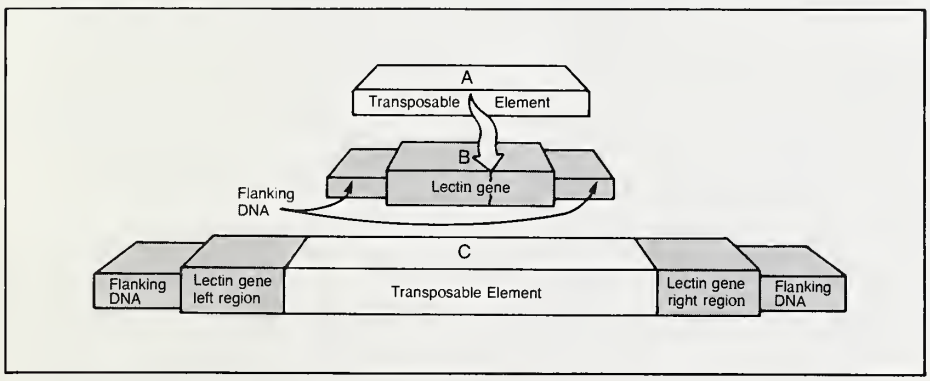
"Our major research emphasis is to learn how genes control traits in soybeans, Vodkin says. "Clearer understanding of genetic blueprints, in turn, should add to the ability of breeders to design better crops."

The growing tool chest of gene-splicing enzymes and recombinant DNA techniques used by molecular biologists has made it possible to cut-and-paste genes from higher plants at random into the DNA of bacterial host cells. The problem is how to identify from among the collection of cloned genes which one represents a particular plant protein or trait of interest.

This is not an easy task, as most traits important to the plant breeder, such as leaf size, plant height, pod fill, or disease resistance usually involve many genes.

Since transposable elements have the ability to move around within an organism's DNA, they can insert into genes and create mutations.

If the mutation occurs in an observable fashion, such as an abnormal shortness or tallness, unusual flower color, or other trait, the geneticist then knows that the transposable element has inserted into a gene that controls that trait.




Transposable element (A) from an unknown location in soybean chromosomes invades lectin gene from normal soybean seed (B) to create a mutant gene (C) associated with the lectinless soybean line. Flanking DNA, which normally controls lectin gene activity, is unchanged—thus leaving the transposable element as the cause of mutant gene's failure to produce a protein. (PN-7182)

After identifying and isolating useful genes with the possible help of movable soybean genetic elements, Vodkin and her colleagues will develop cell tissue cultures such as these, to modify soybean germplasm and, ultimately, help plant breeders design better crops. (0658X508-21A)

It is then possible to recover the transposable element from the genetic material of the mutated plant along with enough of the trait-carrying gene to allow its identification and purification from the collection of cloned genes.

Once the gene is isolated, it serves as a powerful tool to find out how it controls a specific protein production. This information is essential before genetic engineers can modify these traits.

"Our aim is to determine whether Tgm1 or a related element can be used to identify genes in this manner for soybeans," Vodkin says.

As yet, the Tgm1 element has not been shown to actively move from the lectin gene to other locations. The element may be but one of a family of related transposable sequences in soybeans, however. Vodkin and Rhodes are currently investigating the nature of these related sequences.—**Stephen Berberich,** Beltsville, MD.

*Lila O. Vodkin and Patsy Rhodes are located at the Plant Molecular Genetics Laboratory, Bldg. 006, Beltsville Agricultural Research Center-West, Beltsville, MD 20705.* ■

# Alerts Tell Peanut Growers When To Spray

Above: In laboratory studies of peanut diseases at Virginia's Tidewater Research Center, agricultural engineer James L. Steele (right) and plant pathologist Patrick Phipps observe the progress of *Cercospora* leaf spot fungus on peanut leaves. (0585X433-11A)

Right: At a field weather station, Steele inspects an anemometer for damage caused by weathering. Electronics technician Clarence N. Burkholder checks the station's microprocessing system. (0585X437-9)

Midafternoon, September 11.

Barron Britt records an alert on a telephone-answering machine at a Suffolk, VA, research center—

*"The Virginia Peanut Leaf Spot Advisory for Tuesday, September 11, advises that weather conditions in Holland, Capron, and Waverly will continue to be unfavorable for leaf spot development due to cool night temperatures."*

For Virginia's peanut growers, that message, along with previous days' advisories, meant money in the bank. They would not have to spray their fields with fungicides the next day to protect their crops against *Cercospora* leaf spot disease.

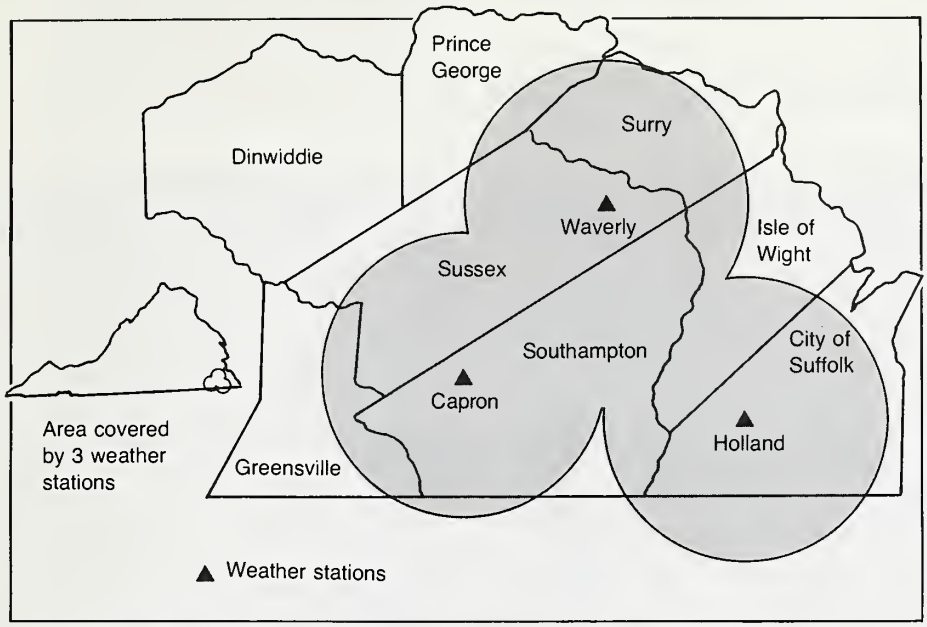
Since 1981, Britt and her supervisor, Patrick Phipps—both from the Plant Pathology Department of Virginia Polytechnic Institute and State University (VPI)—have been recording messages 7 days a week during the growing season. Local radio and television stations often use the information in their newscasts.

Each day's advisory is the result of more than 43,000 measurements of relative humidity and temperature taken during the preceding 5 days at three weather stations in Virginia's peanut-growing region.

A computer processes the data, correlates it with facts about the disease's development, and prints statements telling whether or not the disease is likely to progress and why.

The computer program that makes these predictions takes three continuously measured inputs—time, temperature, and relative humidity—and makes calculations based on an experimentally verified fact: leaf spot infection will spread rapidly when relative humidity has been at or above 95 percent for 10 hours or longer each day for 2 consecutive days, provided the temperature during these periods has remained above 70°F.

Researchers in Georgia developed the peanut leaf spot model, and Agricultural Research Service scientists at Virginia's Tidewater Research Center in Suffolk are developing




This map shows the weather stations used to give Virginia peanut farmers leaf spot disease advisories. Each station covers a 15-mile radius, and together the three stations monitor 80 percent of Virginia's peanut-growing area. (PN-7183)

Steele (left) and plant geneticist Terry A. Coffelt compare the actual flowering patterns of diverse peanut varieties to computer-predicted flowering patterns based on a peanut growth model and weather data. (0585X434-30A)

models for other peanut diseases, particularly *Sclerotinia* blight.

D. Morris Porter, the ARS research leader at Suffolk, says that the research needed to develop predictive models "requires expertise from many scientific specialties. To model these diseases, the first step will be basic research to define the environmental conditions under which the disease organisms thrive. After this will be the development of equations and models that relate environmental variables to disease development. Then comes validation of the model in field tests—does it actually work?"

The data needed to make these models practical in Virginia is provided by a computerized network of weather stations known as the Agro-Environmental Monitoring System. Initiated in 1974 by VPI and the National Aeronautics and Space Administration, it has been a cooperative responsibility of the university and ARS since 1982.

"When the network faced termination because of funding difficulties, we offered our assistance to maintain a reduced operation," says James L. Steele, the ARS agricultural engineer in charge of the system. "The data collected is invaluable to peanut growers and to our crop-production research."

The network has four remote, automated weather stations tied to a central computer at the Tidewater center. Each weather station collects agriculturally related weather data every minute of every day, including wind direction and speed, barometric pressure, total solar radiation, rainfall, dewpoint temperature, air temperature, and soil temperature at 2-, 4-, and 18-inch depths.

The weather station computers calculate weighted averages or accumulations of the data over 10-minute periods, store the results, and transmit them when called by the central computer. Ultimately, the data is stored at VPI. "We're now storing about 5 million pieces of weather information a year," Steele says.

Most people would say this mass of data is more than they care to know about the weather. "But," Steele says, "we need this type of data—collected daily—to develop computer models that can be used to accurately predict plant growth and pest development."

Steele says ARS has formed a network of researchers in peanut-growing areas throughout the nation to develop an overall peanut growth model that can be the basis for daily management models such as the peanut leaf spot model.

Colleague Terry A. Coffelt, a geneticist, says peanut production could be increased if scientists could predict days of heavy flower bloom for peanut plants, giving farmers a chance to avoid field operations that might hinder peanut development. "For example, maybe pesticide spraying adversely affects the development of flowers that have just opened. If so, growers might need to curtail operations on days of heavy bloom." Coffelt says that currently, "only about 30 percent of the flowers develop into peanuts."

"If we can successfully predict flowering," Steele says, "we'll have a basis for making certain management decisions and possibly yield predictions. Think what it would mean to growers if there were a way to predict how environmental conditions are going to influence yield weeks in advance of harvest! They could mitigate the adverse effects of weather. For instance, if we can predict which soil moisture variations will adversely affect yield, growers can make sound economic decisions about irrigating."

Research such as is being done at Tidewater paves the way for more daily, computer-predicted advisories that take a little bit of the uncertainty out of farming.—**Donald Comis,** Beltsville, MD.

*D. Morris Porter, Terry A. Coffelt, and James L. Steele are at the USDA-ARS Peanut Production, Diseases, and Harvesting Research Unit, Tidewater Research Center, P.O. Box 7099, Suffolk, VA 23437.* ■

# New Vaccines: A Bluetongue Guard For Livestock

Veterinarian Thomas Barber (left) and biological laboratory technician Lee Thompson inject a sheep with a killed-virus bluetongue vaccine. Blood samples will be taken every other day and tested for live virus. After 6 to 8 weeks, immunity of the animal will be "challenged" by injecting live virus. (0385X199-3A)

New killed-virus vaccines to protect livestock against bluetongue disease have been developed by ARS research at the Plum Island (NY) Animal Disease Center.

Gamma rays destroy the interior genes of the virus without harming its protein coat, according to microbiologist Charles H. Campbell, so that in the body of an animal, the virus coat is still recognized as foreign and thus triggers antibodies to form against the virus.

Campbell says so far the new vaccines have been successfully tested against two of the five strains of bluetongue virus that exist in the United States. Worldwide, there are 24 strains.

Since the new vaccines are made of particles of killed virus, they are safer to livestock than are live-virus vaccines, Campbell says. A live-virus vaccine against bluetongue type 10, already available in the United States, is approved for use in sheep, he says. However, live-virus vaccine may revert to a virulent form, or it may cause birth defects if given to pregnant animals.

Bluetongue disease causes mouth sores, lameness, abortion, birth defects, and death in sheep and deer. Cattle, the main carriers of the bluetongue virus, do not become sick when infected. Gnats transmit the virus from cattle to sheep.

Bluetongue costs the U.S. cattle industry an estimated $30 million annually in lost sales of cattle, semen, and embryos to overseas markets that fear introduction of the disease, according to Campbell.

Dollar losses to the entire U.S. livestock industry cannot be estimated due to problems in bluetongue diagnosis. Infected livestock may show no outward sign of disease at all, he says.

Campbell developed the new vaccines using laboratory mice. Tests on sheep were then conducted by veterinarian Thomas Lynn Barber at the Arthropodborne Animal Diseases Laboratory, Denver, CO.

Top: The tiny gnat, *Culicoides varipennis*, that transmits the bluetongue virus from cattle to sheep, is about one-tenth the size of a mosquito. (0280X152-26)

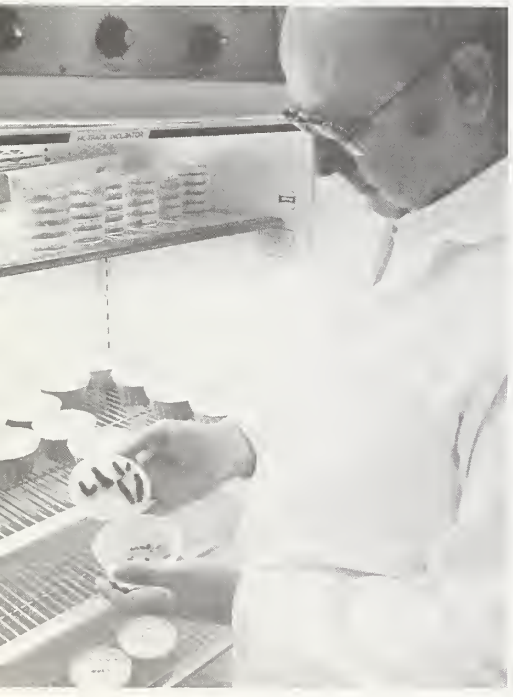
Above: Plum Island, which lies off the eastern tip of Long Island, NY, is home for the USDA-ARS Animal Disease Center where new killed-virus vaccines against bluetongue disease have been developed. (0476X341-19)

At the Arthropod-Borne Animal Disease Research Lab, Denver, CO, Lee Thompson inspects 11-day-old embryonated chicken eggs. To make certain a new killed-virus vaccine against bluetongue disease does not contain live virus, blood from vaccinated sheep is injected into the eggs; the presence of live virus will result in the death of chicken embryos. (0385X200-16A)

Bluetongue virus exists in most parts of the United States, with greatest incidence in some southern and western states, the scientist says. The new bluetongue vaccines could be in the hands of farmers and veterinarians in 5 to 6 years if further tests also succeed, Campbell says.—**Vincent Mazzola,** Beltsville, MD.

*Charles H. Campbell is located at the Plum Island Animal Disease Center, P.O. Box 848, Greenport, NY 11944.* ■

# Gypsy Moth-Killing Fungus?



U.S. scientists are testing a killer fungus as the latest weapon in the war against the gypsy moth.

The imported fungus is a potent killer in Japan, says Richard S. Soper, Jr., insect pathologist at Ithaca, NY.

"If our lab and field tests go well," says Soper, "we'll move into the classic biological warfare strategy of introducing an exotic agent and helping it spread to fight the target pest."

Soper traveled to Japan last year and searched for dead gypsy moths from which he isolated four living strains of the fungus *Entomophaga aulicae*. The cultures are now thriving in his laboratory at the Boyce Thompson Institute at Cornell University.

Although Japanese scientists first reported on the fungus and how it controls gypsy moths early in this century, isolating and propagating living specimens was not possible until recently, Soper says. For example, a New England entomologist collected specimens in 1908 but was unable to propagate them.

Soper injected spores from his collected specimens into native gypsy moths and killed more than 90 percent of them. The gypsy moths were obtained from a USDA rearing facility in Massachusetts.

According to Soper, the fungus lies dormant in the soil most of its life. After the fungus breaks dormancy to breed, it releases tiny spores that land on the gypsy moth larva's body. The spores then germinate and bore inside their host to feed and grow, eventually killing it.

The fungus is only known to attack larvae of gypsy moths, but it will be thoroughly tested against beneficial insects, Soper says.

In Japan, the fungus "sweeps through gypsy moths until the population simply collapses," Soper says.

Recently, entomologist Mitsuaki Shimazu of the Forest and Forest Products Institute, Tsukuba, Japan, joined Soper to study the conditions under which the imported fungus would thrive in U.S. forests.

Above: Infected gypsy moth larvae being consumed by a fungus imported from Japan. (1284X1881-15)

Left top: Visiting entomologist Mitsuaki Shimazu, from the Forest and Forest Products Institute, Tsukuba, Japan, checks gypsy moth larvae for infection by fungus. (1284X1880-13A)

Left bottom: Richard S. Soper, Jr., research leader at the USDA-ARS Insect Pathology Unit in Ithaca, NY, removes gypsy moth larvae from an incubator for tests of a fungus that may someday be used to control gypsy moths. (1284X1880-5A)

The scientists are using growth chambers that simulate the environment of the Northeastern United States, where gypsy moths are particularly destructive.

Soper says the fungus may be released for an initial field test in early 1985.

The fungus could someday be turned into a microbial insecticide, Soper says. The spore-producing parts of the fungi would be ground into a powder for spraying over infested forests. As the powder got wet, it would produce the spores that attack gypsy moths.

Technology already exists for producing microbial insecticides against such pests as spruce budworms and leafhoppers, Soper says.—**Russell Kaniuka**, Beltsville, MD.

*Richard S. Soper, Jr., is at the Insect Pathology Research Unit, USDA-ARS, Boyce Thompson Institute at Cornell University, Ithaca, NY 14853.* ■

## Soil Tester Combines Two Important Measurements

Soil moisture and salinity can be measured simultaneously with a device first developed to find breaks in underground telephone cables, according to Agricultural Research Service scientists at Riverside, CA.

Francis N. Dalton, soil physicist at the U.S. Salinity Laboratory there says, "Previously, two separate instruments were needed, and each was complicated, expensive, and time consuming. This tool is easier to use and more accurate because it measures soil water content and salinity in the same soil sample, rather than two different samples. Also, there is no radiation hazard as there might be with the neutron probes that are currently used to measure water content."

Dalton says that several years ago, Clark Topp, a Canadian soil physicist, proved the cable tester could be used to measure soil water content. Dalton's contribution was the discovery that it could measure soil salinity at the same time.

The cable tester, which is commercially available, uses a technique called time-domain reflectometry.

Dalton uses portable equipment to send electrical signals through a pair of soil probes, measuring soil water content by the amount of time it takes the signal to travel through the soil and back and salinity by the strength of the returning signal.

Currently, the equipment costs about $10,000, but Dalton expects the price to drop as the number of manufacturers grows. A Canadian firm is already selling a version of the cable tester.

Dalton says the device will be useful for researchers, irrigators, and anybody else who needs to measure soil water content and salinity.

Co-discoverers of the cable tester's potential include ARS researcher James D. Rhoades and William N. Herkelrath, a physicist for the U.S. Geological Survey, Menlo Park, CA.—**Dennis Senft,** Albany, CA.

*Francis N. Dalton and James D. Rhoades are at the U.S. Salinity Laboratory, 4500 Glenwood Drive, Riverside, CA 92501.* ■

University of California's Thomas Jones checks tester with a soil column for which salinity and moisture levels are known. (0685X506-30)

## Rabbit Blood Serum Detects Pesticides in Soil, Water

Minute pesticide residues can be rapidly detected in soil or water by a simple assay patterned after the former, well-known rabbit test for human pregnancy.

Agricultural Research Service agronomist Bohn D. Dunbar first modified the immunoassay technique used in pregnancy detection to detect residues from atrazine, which is commonly used to kill weeds during a fallow period before wheat is planted. The detection of atrazine residue is important because it can severely reduce wheat yields.

Dunbar developed a way to attach the relatively small atrazine molecules to larger protein molecules. Then he injected them into rabbits. He says, "The rabbits' immune system recognizes the atrazine and protein molecules as a foreign substance and produces antibodies to combat this invasion. The antibodies are specific to whatever the foreign substance is."

"By taking blood from the rabbit, which now has antibodies specific for atrazine, I can use standard assay tests to indicate how much atrazine is present in the sample," Dunbar says.

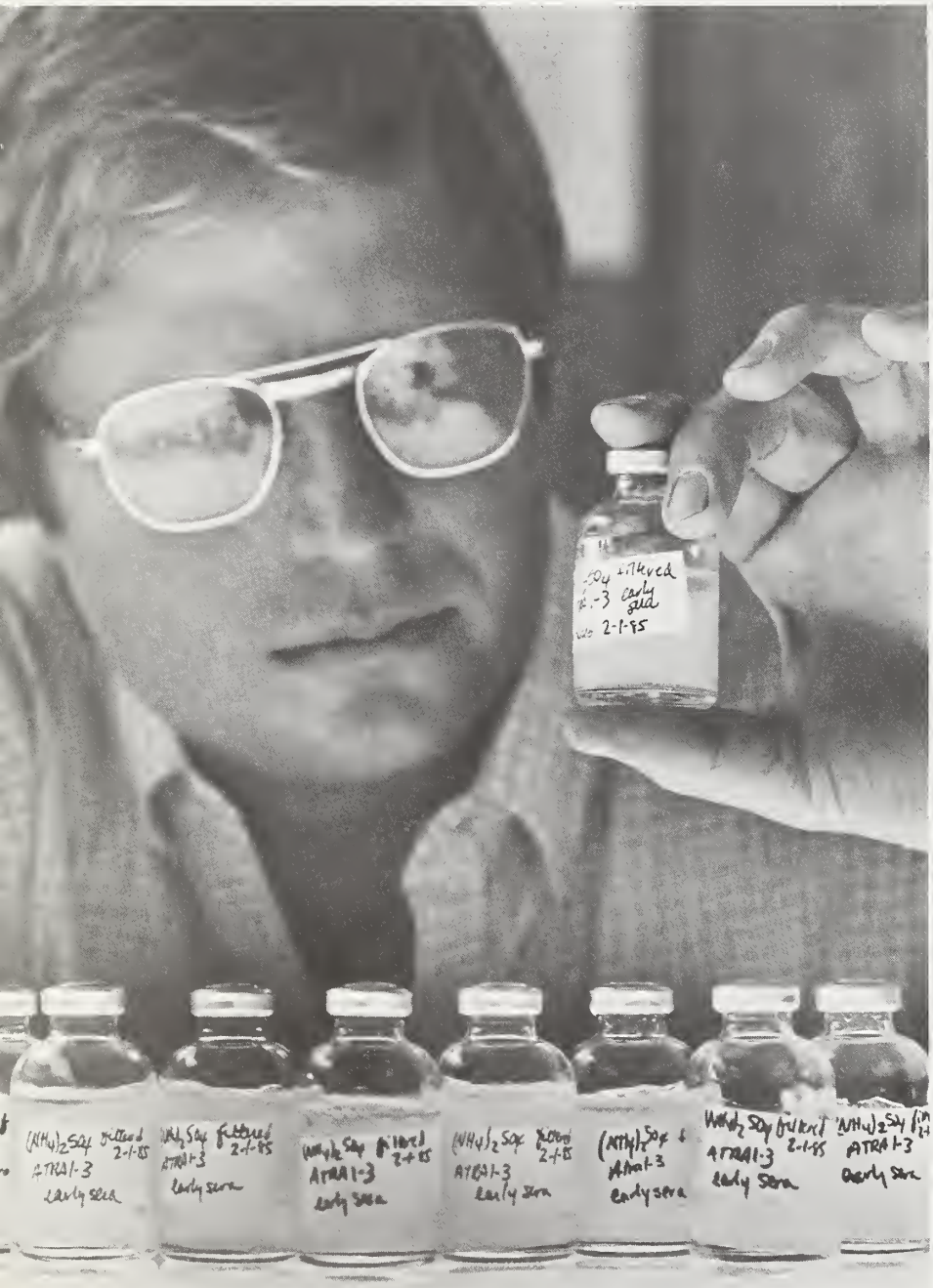
Although he developed the technique to detect pesticides in soils, Dunbar says it can pinpoint pesticides in other materials, such as food and water.

Dunbar's technique measures pesticide residue in concentrations as low as one part per billion. He explains that this is like detecting one drop of vermouth in 500 barrels of gin. "We are adapting the assay to detect a dozen other widely used herbicides and insecticides."

"Other tests exist that are as sensitive as this technique," he says, "but they are far more time consuming and expensive and require highly skilled technicians using expensive equipment. I envision private industry developing simple kits similar to the home pregnancy test kits."

Warren C. Shaw, formerly the ARS research leader for agricultural chemicals technology, says the assay "could have potentially far-reaching implications for government and private organizations that monitor pesticides. Agencies and laboratories will be able to distinguish and measure closely related pesticides. That means monitoring can be rapid and extremely precise."—**Dennis Senft,** Albany, CA.

*Bohn D. Dunbar is at the USDA-ARS Central Great Plains Research Station, P.O. Box K, Akron, CO 80720.* ■



Bohn D. Dunbar, at the USDA-ARS Central Great Plains Research Station in Akron, CO, views bottles of rabbit blood serum, enough to detect the herbicide atrazine in several million liquid samples of soil, water, food, or other materials. (0285X137-8)

Above. Dunbar holds a microplate with 96 samples to be analyzed for pesticide concentrations. Thanks to a computer connected to the microplate reader, he can analyze these samples in seconds. A totally automated system would be able to analyze 2,000 samples a day. (0285X135-33A)

Left: Dunbar holds a "big buck" that produces antibodies for the pesticide tests. These large rabbits are bred for long ears with tips that permit blood to be drawn painlessly. Dunbar, who raised rabbits as a boy, upholds humane standards for their care and handling. (0285X134-14A)

## Wood Preservatives for Beehives

While some wood preservatives are safe to use on beehives, others are not.

Agricultural Research Service scientists at Madison, WI, began a study of the preservatives in 1980, using new hives built of clear ponderosa pine sapwood. Benjamin F. Detroy, at the time an ARS engineer at Madison, and Martins A. Kalnins, a USDA Forest Service chemist, treated a number of hives with different wood preservatives and left others untreated for comparison.

The scientists found that hives treated with pentachlorophenol (PCP) killed some bees and that beewax and honey from these hives contained high concentrations of the wood preservative. Even after 2 years, honey from these hives still averaged 143 parts per billion of PCP.

Eric H. Erickson, Jr., who heads the ARS North Central States Bee Research Laboratory at Madison, says there is a need for wood preservatives in the bee business, especially in the more humid southern states. In Wisconsin researchers saw decay attack untreated hives in just 3 years, eating away at the bottom boards and top covers.

Wood preservatives can extend the life of a hive to 20 years or longer, Erickson says. Safe preservatives currently available are those made with copper naphthenate, acid copper chromate, or copper-9-quinolinolate. However, some chemicals that are definite "no-no's" for bees are chromated copper arsenate (CCA) and tributyl tin oxide.

Erickson warns that all wood preservatives are pesticides and should be used judiciously, and only if registered by appropriate state and federal agencies. The Environmental Protection Agency has published its intent to cancel registration of the wood preservatives PCP, CCA and other inorganic arsenicals, and creosote—unless certain modifications are made to the container labels. Beekeepers should always check for information about potential effects before using any wood preservatives.—**Ben Hardin,** Peoria, IL.

*Eric H. Erickson is at the USDA-ARS Bee Research Unit, 436 Russell Laboratories-Entomology, University of Wisconsin, Madison, WI 53706.* ■

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# PATENTS

### Collecting Cells From Live Animals

Up to now, scientists have had to sacrifice animals to collect monocytes, white blood cells that are important to an animal's ability to fight disease. Now the cells can be collected continuously from a live animal, by a disposable device implanted in the abdominal cavity.

The device is a hollow, spherical chamber with membrane-covered holes through which the monocytes enter. The chamber has an inlet and outlet conduit on opposite sides, so monocytes can be flushed from the chamber without the sphere being removed.

The device can be left in to collect monocytes for long periods and can be removed without harming the animals.

Not only does the device protect laboratory animals, but it also collects more and better quality monocytes than existing methods.

For technical information, contact Phillip H. Klesius, ARS Regional Parasite Research Laboratory, P.O. Box 952, Auburn, AL 36830. *Patent No. 4,505,277, "Implantation Device for Use in In Vivo Stimulation and Collection of Monocytes From Peritoneum of Vertebrate."* ■

### New High-Pressure Lubricant Additives

The discovery of a new class of compounds has led to extreme-pressure lubricant additives that are effective substitutes for the restricted sulfurized sperm whale oil.

This invention is a way to chemically prepare the additives, using tetrasulfide compounds derived from petroleum or vegetable oils.

Lubricants treated with tetrasulfide additives may be used as crankcase oils, transmission oils, cutting oils, extruding oils, rolling oils, drawing oils, continuous steel casting lubricants, and for other industrial uses demanding lubrication of contacting surfaces at high pressures.

For technical information, contact Arthur Schwab, Northern Regional Research Center, 1815 North University Street, Peoria, IL 61604. *Patent No. 4,218,332, "Tetrasulfide Extreme Pressure Lubricant Additives."* ■

### Fruit Fly Mass Production

A tube method of egg collection for mass-producing fruit flies should be a boon to sterile-insect release programs such as the Mediterranean fruit fly program.

With this method, the flies lay their eggs in perforations in a tube that extends lengthwise through their cage. After the eggs are laid, the tube is flushed with water to carry the eggs into a collection container.

Because of the design of the tube, flies lay 44 percent more eggs than with the screen method, the most popular technique, and 14 percent more than with the bottle method, which was used in 1980 to raise sterile male flies to combat the California medfly infestation. Labor is reduced 70 percent from that required for the bottle method.

The tubes do not have to be removed to collect eggs, as the bottles do, eliminating a time-consuming procedure and reducing the chance of flies escaping.

For further technical information, contact Roger I. Vargas, Tropical Fruit & Vegetable Research Laboratory, P.O. Box 2280, Honolulu, HI 96804. *Patent Application Serial No. 696,222, "Improved Method and Apparatus for the Mass Rearing of Fruit Flies."* ■

### *Patents Available for Licensing*

A catalog listing all U.S. Department of Agriculture patents is available on request. If you are interested in receiving the catalog or applying for a license on a patent, write to the Coordinator, National Patent Program, USDA-ARS, Rm. 401-B, Building 005, Beltsville Agricultural Research Center-West, Beltsville, MD 20705. ■